User's Guide

RCX C-Link Series:
Remote Camera Link Extenders

for use with Camera Link cameras

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RCX C-Link Series: Remote Camera Link Extenders

Overview

EDT's RCX-series remote Camera Link extenders are compact modules that can be used to extend Camera Link data over fiberoptic or coaxial cabling. All components work just as they do with Camera Link cabling.

This guide covers the following extenders: the RCX C-Link, which works with fiberoptic cable; and the RCX C-Link Coax2, which works with coaxial cable. Thus, for simplicity, this guide will refer to them as follows:

- RCX C-Link — Fiber extender
- RCX C-Link Coax2 — Coax extender

Two extenders can link a camera to a standard framegrabber via fiber or coaxial cable; or one extender can connect a camera to an EDT FOX framegrabber, which has fiberoptic transceivers built in.

Specially configured pairs are available for medium or full mode operation (fiber version only).

NOTE All EDT extenders and framegrabbers mentioned in this guide are for Camera Link. For details on our legacy AIA product, RCX LVDS / RS422, see its product page at www.edt.com.

Care and Cautions

Your EDT extender is built to withstand a variety of extreme conditions, as listed in the specifications on its datasheet (see Related Resources on page 6). However, it is nonetheless a high-performance component which, for optimal results, should be treated with care, as detailed below.

- The extender must be protected from even momentary power spikes over 18 volts.
- The connectors – especially the fiberoptic transceivers – must be kept clean and dry. If you suspect the presence of moisture or debris in the connectors, you should blast a burst of compressed air:
  - directly into the ports to dislodge any debris that has collected there; and
  - away from the electronic components to blow out any moisture that has collected in the air nozzle.

CAUTION To avoid damaging your eyesight, never look directly into any transceiver.

Related Resources

The resources below may be helpful or necessary for your applications.

- To find complete EDT information on any EDT product, go to www.edt.com and find the appropriate product page. That page will provide links to the product's datasheet specifications and user's guide.
- To find EDT information that is not related to a specific EDT product (for example, installation packages or cable pinouts for multiple products), go to www.edt.com and look in Product Documentation.

EDT Resource	Detail	Web link
• Application programming interface	HTML and PDF versions	www.edt.com/manuals.html
• Installation packages	Software / firmware	www.edt.com/software.html
• Specifications for EDT products	Datasheets	www.edt.com (find by product name)
• Documentation for EDT products	User's guides	" (Product Documentation page)
• Cabling and pinout documentation	Details on cabling and pinouts	" (Product Documentation page)

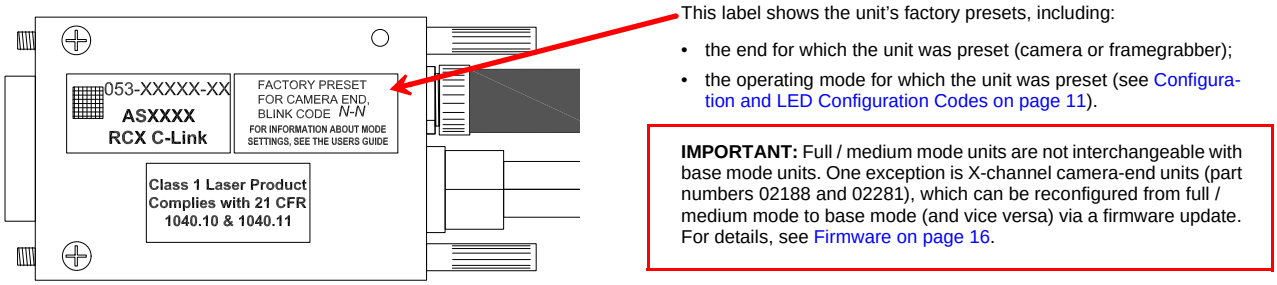
Standard / Specification	For	From	Web link
• PCI / PCIe	PCI / PCIe bus	PCI Special Interest Group (PCI SIG)	www.pcisig.com
• Camera Link	Camera Link	Vision Online (VO)	www.visiononline.org
• IRIG-B	IRIG-B timestamping	Inter Range Instrumentation Group mod B	irigb.com

Connecting the Extender Assembly

Each extender unit is factory-preset and labeled to connect to either a camera or a framegrabber (Figure 1). Each unit, in order to work properly, must be connected to the device for which it was preset and labeled.

NOTE If you reconfigure your extender for a different device, relabel the extender to avoid future confusion.

Figure 1. Fiberoptic extender, labeled with factory presets


053-XXXXX-XX
ASXXXX
RCX C-Link
FACTORY PRESET
FOR CAMERA END,
BLINK CODE N-N
FOR INFORMATION ABOUT MODE SETTINGS, SEE THE USERS GUIDE
Class 1 Laser Product
Complies with 21 CFR
1040.10 & 1040.11
This label shows the unit's factory presets, including:
• the end for which the unit was preset (camera or framegrabber);
• the operating mode for which the unit was preset (see Configuration and LED Configuration Codes on page 11).
IMPORTANT: Full / medium mode units are not interchangeable with base mode units. One exception is X-channel camera-end units (part numbers 02188 and 02281), which can be reconfigured from full / medium mode to base mode (and vice versa) via a firmware update. For details, see Firmware on page 16.

Once you have checked the labeling, you can connect each extender as explained below.

- Device end: Attach the correct device (camera or framegrabber) to the extender's MDR26 connector.
- Cable end: Attach the correct cable to the extender's cable connectors.

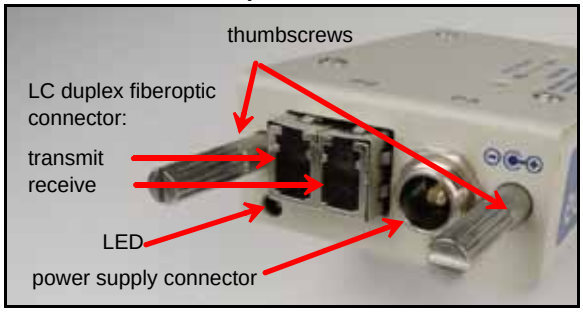
Figure 2 shows the extender connectors and other features, including the LED (see The LED on page 11).

Figure 2. Connectors and features on EDT extenders

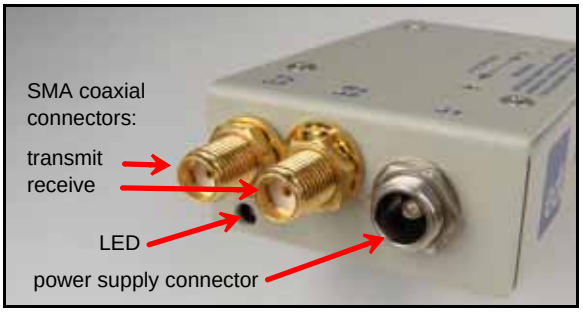
Device end of an extender

An extender connected to a camera

Cable end of a fiberoptic extender



Cable end of a coaxial extender



Mounting the Extender

To mount an extender, use the thumbscrews or one of the alternative methods detailed in Alternative Mounting and Connecting Methods on page 25. To mount a coax extender, you must use one of those alternative methods.

Base Mode

For this setup, you'll need two extenders (one at the camera end and one at the framegrabber end) or, if you use an EDT FOX framegrabber, just one extender (at the camera end).

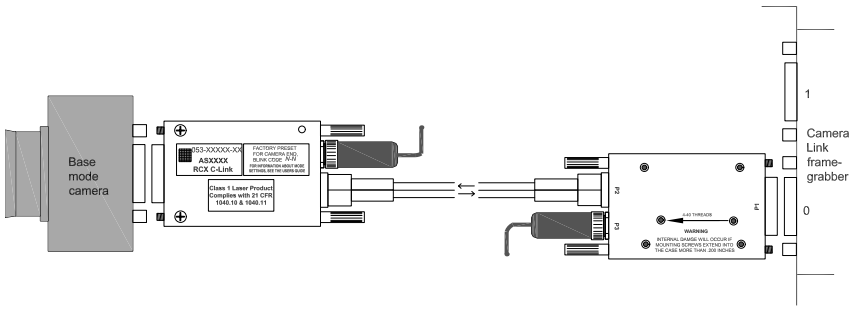
In base mode, each pixel clock transfers 24 bits of video data from the camera's X channel. The extender can transfer four camera control signals and has a bidirectional serial interface between framegrabber and camera.

NOTE The extender generates its own pixel clock, so the clock rate into the framegrabber may exceed the rate of the camera. Thus, the amount of time spent in blanking will vary from line to line and frame to frame.

With a standard framegrabber

For a base-mode system with a standard framegrabber, you will need two extenders: one at the camera end and one at the framegrabber end (see Figure 3).

Figure 3. Base mode: multiple extenders + standard framegrabber



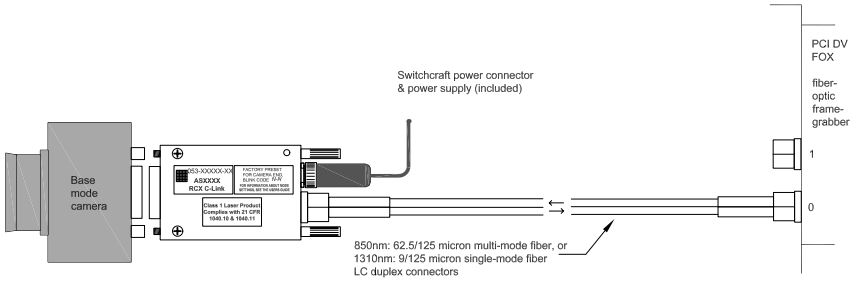
To set up this system:

1. Install the framegrabber according to its user's guide (for EDT user's guides, see Related Resources on page 6).
2. Verify the extenders are configured properly (see Configuration and LED Configuration Codes on page 11) – one for the camera end, and the other for the framegrabber end.
3. Turn off power to all devices.
4. Connect the extender labeled "Camera End" to the MDR26 connector on the camera (see Figure 2).
5. Connect the extender labeled "Framegrabber End" to the MDR26 connector on the framegrabber.
6. Connect the two extenders to each other with the appropriate fiberoptic or coaxial cable.
7. Connect the power supply to the power connector on the back of the extender.
8. Turn on power to all devices.
9. Verify each LED shows a steady light (see Status and LED Status Codes on page 15).

With a FOX framegrabber

A FOX framegrabber has fiberoptics built in, so a base-mode system with a FOX framegrabber requires only one extender per camera (see Figure 4).

Figure 4. Base mode: one extender + FOX framegrabber



To set up this system:

1. Install the framegrabber according to its EDT user's guide (see Related Resources on page 6).
2. Verify the extender is configured properly (see Configuration and LED Configuration Codes on page 11).
3. Turn off power to all devices.
4. Connect the extender to the MDR26 connector on the camera (see Figure 2).
5. Connect the extender to the desired transceiver on the framegrabber (channel 0 is the transceiver physically closest to the PCI bus) with fiberoptic cable.
6. Connect the power supply to the power connector on the back of the extender.
7. Turn on power to all devices.
8. Verify each LED shows a steady light (see Status and LED Status Codes on page 15).

Medium or Full Mode

A medium- or full-mode system requires multiple extenders, as explained below.

On a medium- or full-mode Camera Link camera, there are two MDR26 connectors.

- The *primary connector* operates the same way as the base-mode interface: each pixel clock transfers 24 bits of video data from the camera's X channel. The primary connector also can transfer four camera control signals, and it has a bidirectional serial interface between framegrabber and camera.
- The *secondary connector* transfers video data for the Y and Z channels:
  - — Medium-mode cameras transfer 24 bits of video data for the Y channel.
  - — Full-mode cameras transfer an additional 24 bits for the Z channel.

Thus, the standard full-mode configuration transfers 72 bits of video data — 24 bits each for the X, Y, and Z camera channels.

The X-channel extenders (one at the camera end and one at the framegrabber end) operate as a base-mode extension cord, with one fiber for video data from camera to framegrabber, and the other for control signals from framegrabber to camera. The YZ-channel extender at the camera end has two fiberoptic transmitters, with both fibers carrying video data to the framegrabber.

Many framegrabbers require that the video data presented at the primary and secondary connectors must be synchronized to within a fraction of a pixel clock. The section entitled Cable assembly – Lemo resync on

page 22 describes a common pixel clock for both extenders at the framegrabber end, and other synchronizing signals to ensure that the starting pixel of each raster lines up across the X, Y and Z channels. The resync cable also supplies power to the extenders.

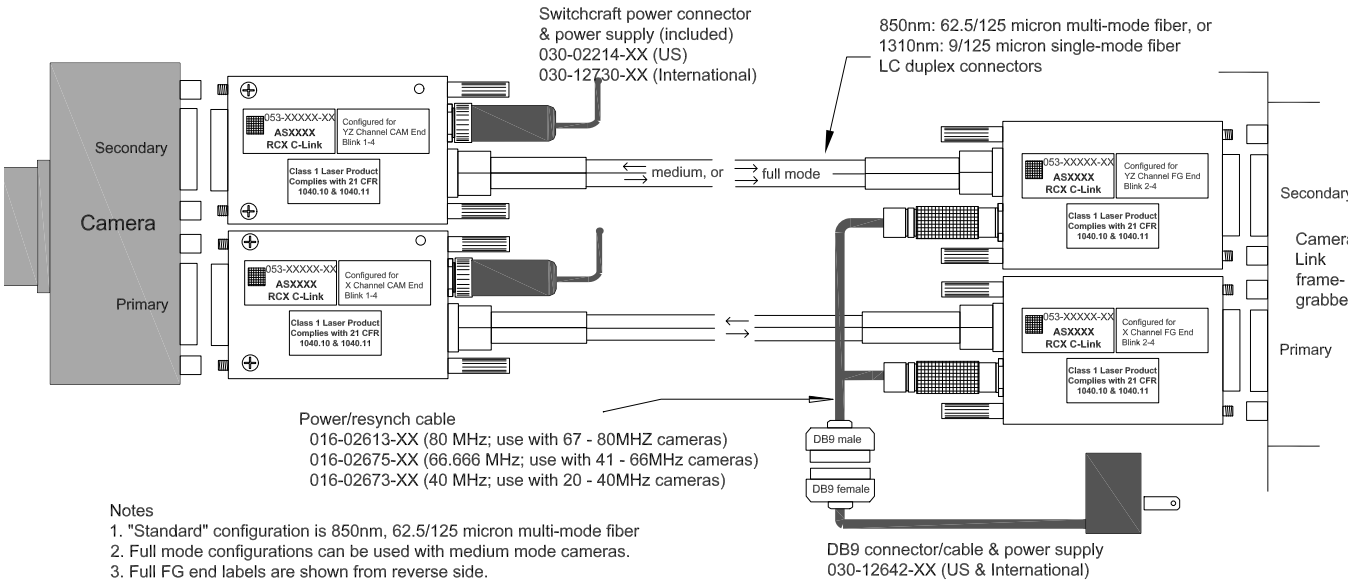
CAUTION To avoid damaging your components, you should verify that the entire system is connected properly before you apply power to any component. In particular, do not apply power to the resync cable while you are connecting it to, or disconnecting it from, an extender.

With a standard framegrabber

For medium- or full-mode operation with a standard framegrabber, you will need four extenders: two at the camera end, and two at the framegrabber end (see Figure 5).

NOTE Each extender unit is physically different from the others, so you cannot simply change the configuration codes and use the units interchangeably.

Figure 5. Full mode: multiple extenders + standard framegrabber


Switchcraft power connector
& power supply (included)
030-02214-XX (US)
030-12730-XX (International)
850nm: 62.5/125 micron multi-mode fiber, or
1310nm: 9/125 micron single-mode fiber
LC duplex connectors
Secondary
Camera
Primary
medium, or
full mode
053-XXXXX-XX
ASXXXX
RCX C-Link
Configured for YZ Channel CAM End Blink 1-4
Configured for X Channel CAM End Blink 1-4
Configured for YZ Channel FG End Blink 2-4
Configured for X Channel FG End Blink 2-4
Class 1 Laser Product Complies with 21 CFR 1040.10 & 1040.11
Secondary
Camera Link frame-grabber
Primary
Power/resynch cable
016-02613-XX (80 MHz; use with 67 - 80MHZ cameras)
016-02675-XX (66.666 MHz; use with 41 - 66MHz cameras)
016-02673-XX (40 MHz; use with 20 - 40MHz cameras)
DB9 male
DB9 female
Notes
1. "Standard" configuration is 850nm, 62.5/125 micron multi-mode fiber
2. Full mode configurations can be used with medium mode cameras.
3. Full FG end labels are shown from reverse side.
DB9 connector/cable & power supply
030-12642-XX (US & International)

To set up this system:

1. Install your Camera Link framegrabber and software as instructed by its manufacturer.
2. Verify extenders are configured properly (see Configuration and LED Configuration Codes on page 11).
3. Turn off power to all devices.
4. Connect the extender labeled *X Channel Camera* to the camera's primary MDR26 connector.
5. Connect the extender labeled *YZ Channel Camera* to the camera's secondary MDR26 connector.
6. Connect the extender labeled *X Channel FG* to the framegrabber's primary MDR26 connector.
7. Connect the extender labeled *YZ Channel FG* to the framegrabber's secondary MDR26 connector.
8. Connect the two power supplies with coaxial power connectors to the two camera-end extenders.
9. Verify that you have the correct resync cable for your camera (see Figure 5) and connect the cable to both extenders at the framegrabber end. The two ends of the resync cable are interchangeable.
10. Connect the power supply with the 9-pin D-shell connector to the resync cable connector.

11. Connect an LC duplex fiber from the X-channel extender at the camera end to the X-channel extender at the framegrabber end.
12. Connect an LC duplex fiber from the YZ-channel extender at the camera end to the YZ-channel extender at the framegrabber end.
13. Turn on power to all devices.
14. Verify each LED shows a steady light (see Status and LED Status Codes on page 15).

With a FOX framegrabber

A FOX framegrabber for medium and full mode is currently in development.

Eighty-bit packing

Certain full-mode cameras, such as the Basler A04k and Mikrotron MC1310 and MC1311, will reassign the Spare, Data-valid, and Frame-valid control signals to allow a transfer of up to 80 bits of data per pixel clock. Your extender can be configured with a configuration code to accommodate these cameras. Configuration codes of 1-5 (at the camera end) and 2-5 (at the framegrabber end) allow 80-bit packing at frequencies of 60–72 MHz. The 72 MHz upper limit is determined by the bandwidth available over the fiber, but is sufficient to support all modes currently available on the cameras specified above.

The LED

Each extender has a light-emitting diode (LED), as in Figure 2. By displaying various patterns of blinks (blink codes), the LED communicates information about the extender's configuration and status, as follows.

At power-on, the LED blinks a configuration code (indicating the operating mode for which the extender is configured) one time, and then blinks rapidly as the firmware loads. After power-on, the LED continuously displays a status code (indicating whether the unit is working properly or has errors). The LED also is used when resetting or changing the operating mode.

The two types of LED codes are explained more fully in Configuration and LED Configuration Codes on page 11 and Status and LED Status Codes on page 15.

Configuration and LED Configuration Codes

Your EDT extender can support a wide range of camera models and data transfer rates, depending on the extender model and operating mode selected. For fiber extenders, standard firmware will support most base-mode cameras from 20 to 80 MHz, with UART data rates of up to 19.2 Kb/s, and full-mode operation at 60–80 MHz. For coax extenders, standard firmware will support most base-mode cameras from 20 to 60 MHz, with UART data rates of up to 19.2 Kb/s.

Each extender is factory-preset for the operating mode that was specified in the product order. The operating mode is selected and indicated through LED configuration codes, as explained below.

Each extender is configured for the desired operating mode through a pattern of blinks called the LED configuration code. This code, displayed once at power-on, consists of two digits, each represented by a certain number of blinks. The two digits are separated by a pause, shown in this guide as a hyphen. For example, a configuration code of "one blink, pause, one blink" is shown in this guide as 1-1.

A first digit of 1 indicates that the unit is configured for the camera end; a first digit of 2 indicates that the unit is configured for the framegrabber end. The second digit must be the same for both ends (camera and framegrabber). With a FOX framegrabber, there is no extender at the framegrabber end, so the configuration code is set at the camera end only.

For a typical base-mode system, a configuration code of 1-1 at the camera end and 2-1 at the framegrabber end permits standard base-mode operation at clock frequencies of 20–40 MHz. For a typical full mode system, a configuration code of 1-4 on both extenders at the camera end, and a configuration code of 2-4 on both at the framegrabber end, allows standard full-mode operation at clock frequencies of 60–80 MHz.

On the configuration code label for a medium- or full-mode system, *X Channel* refers to the primary MDR26 connnector on the camera or framegrabber, and *YZ Channel* refers to the secondary connector.

Base Mode

Table 1 shows the operating modes of an extender in base mode (EDT firmware revsion 11 or higher).

Table 1. LED configuration codes – base mode

Code	End	Camera Clock Rate	Constraints	Link Rate	Extender Type
1-1	camera	20–40 MHz	24 bits	1.25 Gb/s	Fiber & coax
1-2	camera	20–60 MHz	16 bits	1.25 Gb/s	Fiber & coax
1-3	camera	20–60 MHz	24 bits	2.5 Gb/s*	Fiber only
1-4	camera	60–80 MHz	24 bits	2.5 Gb/s*	Fiber only
2-1	framegrabber	40 MHz	24 bits	1.25 Gb/s	Fiber & coax
2-2	framegrabber	60 MHz	16 bits	1.25 Gb/s	Fiber & coax
2-3	framegrabber	60 MHz	24 bits	2.5 Gb/s*	Fiber & coax
2-4	framegrabber	80 MHz	24 bits	2.5 Gb/s*	Fiber only
3-3	firmware update (see Firmware on page 16)			1.25 Gb/s	Fiber & coax
2 fast, 2 slow, 2 fast	Error: unsupported configuration code entered				

* PCI DV FOX supports rates only up to 1.25 Gb, so it works only with RCX C-Links configured at 1-1 or 1-2.

Cameras operating between 40 and 60 MHz are usually best served by configuration codes 1-3 and 2-3. If the camera needs only 16 data bits or fewer transferred per clock cycle (instead of all 24), it is possible to use configuration codes 1-2 and 2-2 instead, and thus operate the link at 1.25 Gb/s for longer range and lower power dissipation. The selection of 16-bit mode is made only at the framegrabber end through configuration code 2-2, or through the directive `mode16: 1` in a FOX configuration file; this information is communicated over the fiber to the extender at the camera end. (At the camera end, configuration codes 1-1 and 1-2 are identical.)

At reset (and whenever the extender cannot lock to the camera clock), the extender initializes to assume that the Camera Link Data-Valid signal is never asserted, and ignores it. Many Pulnix cameras do not assert Data-Valid, so this behavior is useful for those using such cameras. The first occurrence of Data-Valid true from the camera causes the extender to use Data-Valid to qualify video data from that point on.

In the case of a dual-tap camera, the Camera Link pixel clock is half the camera's pixel rate. For example, a dual-tap 12-bit camera with a 40 MHz Camera Link clock sends 80 million pixels per second. This camera is compatible with the extender in configuration code 1-1.

Medium or Full Mode

Table 2 shows the operating modes of an extender in medium or full mode (EDT firmware rev. 11 or higher).

NOTE This table is for the fiberoptic extender only, as the coaxial extender is available for base mode only.

Table 2. LED configuration codes – medium or full mode

Code	End	Camera Clock Rate	Constraints	Link Rate
1-1	camera	20–40 MHz	72 bits	1.25 Gb/s
1-2	[undefined]	–	–	–
1-3	camera	20–60 MHz	72 bits	2.5 Gb/s
1-4	camera	60–80 MHz	72 bits	2.5 Gb/s
1-5	camera	60–72 MHz	for 80-bit full-mode cameras	2.5 Gb/s
2-1	framegrabber	20–40 MHz*	72 bits	1.25 Gb/s
2-2	[undefined]	–	–	–
2-3	framegrabber	20–60 MHz*	72 bits	2.5 Gb/s
2-4	framegrabber	60–80 MHz*	72 bits	2.5 Gb/s
2-5	framegrabber	60–72 MHz*	for 80-bit full-mode cameras	2.5 Gb/s
3-3	firmware update (see Firmware on page 16)			1.25 Gb/s
2 fast, 2 slow, 2 fast	Error: unsupported configuration code entered			

* For camera clock rate, the resync cable determines the actual frequency.

For full-mode cameras, which typically operate at 60 to 80 MHz, configuration codes of 1-4 (camera end) and 2-4 (framegrabber end) should work. For full-mode cameras that transfer 80 bits per clock cycle, use configuration codes of 1-5 (camera end) and 2-5 (framegrabber end).

For medium-mode cameras, which typically operate at 40 MHz, configuration codes of 1-1 (camera end) and 2-1 (framegrabber end) should work.

For instructions on verifying and updating the firmware, see Firmware on page 16.

Resetting or Changing the Operating Mode

Your extender is factory-preset for the operating mode that was specified in the product order. However, if you need to reset or change the operating mode, you can do so by setting the LED configuration code.

NOTE If you change the operating mode, be sure to relabel the extender to prevent future confusion.

To reset or change the operating mode (configuration code):

1. Turn off the power to the extender, and disconnect the extender from everything except a power supply.

NOTE EDT recommends connecting the power supply to a power strip or some other device that allows easy access to both the power and the extender at the same time. This is because, as you follow the steps below, it may become necessary to turn off the power and restart the process (see step 4).

2. Press the recessed button on the bottom of the extender with a fine, blunt point – such as the tip of a ballpoint pen – as in Figure 6.

Figure 6. Pressing the recessed button

3. Still pressing the button, turn on the power; the LED will turn on.
4. Release the button within two seconds (if you press the button longer than two seconds, the LED will start blinking diagnostically and you will need to restart the process from step 1).
5. Release the button; the LED will turn off.

NOTE Before proceeding, be sure you know which configuration code you want (see Configuration and LED Configuration Codes on page 11), because you'll need to enter it quickly when the LED starts blinking.

6. Press the button, let the LED start blinking, and release the button after the correct number of blinks for the first digit; then repeat for the second digit. For example, for a configuration code of 2-1, press the button for two blinks, and release; then press the button for one blink, and release.

   As soon as you enter the second digit, the extender saves your selection into flash memory and the LED starts blinking in that pattern. If the pattern is not what you wanted, start over from Step 1.

NOTE If an unsupported code is entered, the LED will display two fast, two slow, and two fast blinks, indicating that an error has occurred and the code has not been saved to memory.

7. Cycle power to the extender without pressing the button.

When the extender is powered on without the button pressed, the LED blinks the configuration code once and blinks rapidly as the firmware loads; then it continuously displays the extender's status (see Status and LED Status Codes on page 15).

Backward Compatibility

For details on backward compatibility, see Firmware on page 16.

Status and LED Status Codes

As previously discussed, at power-on the LED blinks the extender's configuration code one time, and then blinks rapidly as the firmware loads. After power-on, the LED continuously displays the extender's status code, which indicates whether the unit is working properly or has errors (see Table 3).

Table 3. LED status codes

If LED shows...	It means...
Steady light	All OK – everything is working properly.
Slow blinks (1Hz)	There is an error from the other end. The typical causes are: • The extender at the other end has no power, or its operating mode does not match the operating mode on this extender (see Configuration and LED Configuration Codes on page 11). • The cable connection is compromised, either by incorrect or damaged cabling, or by moisture or debris in the extender's cable connectors (see Care and Cautions on page 5).
Fast blinks (10Hz)	There is an error from the camera to the extender, related to the camera's pixel clock. If the fast blink is on the camera-end extender: either the camera has no power, or the operating mode on the extender does not match the operating mode on the camera (see Configuration and LED Configuration Codes on page 11). If the fast blink is on the framegrabber-end extender: either the extender or the resync cable is faulty.
Both slow and fast blinks	There is at least one slow-blink error and at least one fast-blink error.
2 fast + 2 slow + 2 fast blinks	The extender is configured with an unsupported operating mode (see Configuration and LED Configuration Codes on page 11).
No light	The extender has no power or is faulty.

Firmware

If you are using EDT FOX or PCI Express framegrabbers and fiber extenders in base or medium mode, you can query and, if appropriate, update the firmware. If you are using anything else, contact EDT to update the firmware.

To avoid version problems, EDT recommends against doing a firmware update unless you are convinced it is necessary. If it is necessary, you can use the utility `rcxload` to query the firmware, verify it against a provided firmware file, and update the firmware.

Versions

EDT extenders are factory-preset with the files shown in Table 4.

Table 4. FPGA configuration files for RCX-series extenders

Camera Link operating mode	Channel	FPGA configuration file
Base	[no channels]	`rgb11.rcx`
Medium	X	`mx11.rcx`
	Y	`my11.rcx`
Full	X	`fx11.rcx`
	YZ	`fyz11.rcx`
IMPORTANT: Full / medium mode units are not interchangeable with base mode units. One exception is X-channel camera-end units (part numbers 02188 and 02281), which can be reconfigured from full / medium mode to base mode (and vice versa) via a firmware update.		

If your extender unit is using standard firmware older than revision 11, the unit will support camera speeds of only 20–40 MHz at 1.25 Gb/s, using a configuration code of 1-1 (ignore Data-Valid), 1-2 (use Data-Valid), or 2-1 (framegrabber end).

For backward compatibility, firmware revisions of 11 or later will behave identically for configuration codes 1-1 and 1-2. As of firmware revision 11, Data-Valid is automatically detected. If you use configuration code 2-2 at the framegrabber end for 16-bit mode, you can use the corresponding configuration code of 1-2 at the camera end.

NOTE To determine whether your firmware is revision 11 or later, you can enter configuration code 3-5 (see Configuration and LED Configuration Codes on page 11). If the LED then blinks two fast, two slow, two fast (indicating an unsupported configuration code), then you have firmware of revision 11 or later.

Querying, Verifying, and Updating

For base or medium mode, follow the steps below to query, verify, and update the firmware.

CAUTION To avoid corrupting the firmware on the extender, do not interrupt the update by pressing Ctrl-C or turning off the power while the update is in progress.

1. Set up your system as instructed in this guide (see Connecting the Extender Assembly on page 7).
2. Run `pciload` with no arguments to ensure that the system recognizes the EDT framegrabber. Typical output appears as shown below.

```
pdv unit 0 (pci dv fox):
XC2S200 PCI FPGA, AMD 29LV081B 8MB FPROM
s/n AP0064, p/n 019-02103-11, i/f fpga xc2s400e, rev 11 clock 40 Mhz, opt f2
Sector 0
Sector 1
Sector 2  PROM  id: <dvtlk4_3v.ncd 2s200fg456 2005/06/10 14:58:10>
Sector 3  PROM  id: <dvtlk4_5v.ncd 2s200fg456 2005/06/10 14:58:16>
```

3. Configure the extender with code 3-3 (see Configuration and LED Configuration Codes on page 11).
4. Power-cycle the extender.
5. If you are using a FOX framegrabber, ensure the fiberoptic cable is connected to channel 0 (the channel physically closest to the PCI bus). The extender need not be connected to a camera.
6. Query the extender, to ensure it is there and recognized, by entering `rcxload` with no arguments. After you start `rcxload`, the LEDs on both devices will be lighted and not blinking.

   Typical output appears thus:

   ```
   pdv unit 0 (pci dv fox) chan. 0 RCX module:
   sector 0 [10000]: <rgb11cm60_a01.ncd 2vp2fg256 2006/03/30 20:05:34>
   sector 1 [38000]: <rgb11cm80_a01.ncd 2vp2fg256 2006/03/30 20:12:36>
   sector 2 [60000]: <rgb11fg40_a01.ncd 2vp2fg256 2006/03/30 19:57:41>
   sector 3 [88000]: <rgb11fg60_a01.ncd 2vp2fg256 2006/03/30 20:02:08>
   sector 4 [b0000]: <rgb11fg80_a01.ncd 2vp2fg256 2006/03/30 20:09:30>
   sector 5 [d8000]: <fud02b.ncd 2vp2fg256 2006/03/28 15:59:19>
   ```

   If your output appears faulty, check the configuration code, cables, and connections. If you still have problems, email the output to tech@edt.com.
7. Assuming correct output from step 6 above, you can perform either or both of the following operations.

   — To verify (compare) the firmware in your EDT installation package against the firmware already loaded on your extender via flash memory, run...

   `rcxload -u 0 -v flash/rcx/`*`file.rcx`*

   ...replacing *`file.rcx`* with the filename of the current firmware revision. The utility compares the firmware in the extender with the firmware in the specified firmware file. If they are the same, the utility reports `verified` and `0 errors;` if not, it reports `not verified` and lists the errors.

   — To update the firmware, if you determine that an update is necessary, run...

   `rcxload -u 0 flash/rcx/`*`file.rcx`*

   ...replacing *`file.rcx`* with the filename of the current firmware revision.

   The filename must be a valid `.rcx` file. EDT software packages ship with the current `.rcx` files in the `flash/rcx` subdirectory. The `README` file in the package has information about any `.rcx` file updates, including the specific filename of the current revision.

   After a successful update, configure the extender for the desired operating mode (see Configuration and LED Configuration Codes on page 11).

NOTE If `rcxload` reports an error within a section flagged as “critical,” do not power-cycle the extender; instead, repeat the procedure. If you still get errors, leave the extender powered on and contact EDT.

You can turn off the power to the computer and camera, and leave the extender powered on indefinitely.

Transceivers

The fiberoptic extender supports various types of transceivers and fiber, as shown in Table 5.

Table 5. Transceiver + Fiber Combinations

Range	Fiber Type	Thickness (microns)	Wavelength	Maximum length (meters)	
				at 1.25 Gb/s	at 2.5 Gb/s
Standard	Multi-mode fiber (MMF)	62.5	850 nm	300	150
		50.0	850 nm	500	250
Extended	Single-mode fiber (SMF)	9.0	1310 nm	10,000	5000

Alternatively, the following transceivers are available as options.

- Single fiber transceivers (distances up to 60 km): These have an integrated passive optical multiplexer and transmit data in each direction over one fiber using different colors of light – especially useful when going through an optical rotary joint.
- CWDM transceivers (extended range of 5 km or more, 1310 nm, single-fiber PON) – These use up to 16 different colors of light, with the light split and combined by passive optical multiplexers that are external to the extender. They support up to twelve different cameras simultaneously over a single fiber.
- DualTX and DualRX transceivers – In full mode, these are used on the secondary Camera Link connector because it must carry twice as much data as the primary connector.

Coaxial Cable

The coaxial extender has two SMA connectors – one for data in, and one for data out. The cable used must have a corresponding SMA connector at each end.

The maximum range is determined by the dB of loss at 625 MHz. EDT recommends using a cable that keeps the amount of loss under 20 dB at 625 MHz.

The cabling must have an impedance of 50 ohms.

One cable type that meets all of these requirements is 50-ohm RG58, which has an SMA connector at each end and a typical loss of 11 to 15 dB per 100 feet.

Pinouts

This section provides pinout information for the Camera Link and power connectors.

Camera Link

Table 6 shows the MDR26 connector pinout for Camera Link signals (base, medium, and full mode).

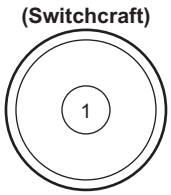
Table 6. Pinout – MDR26 Connector

Camera end	Framegrabber end	Camera Link signal base mode (primary connector)	Camera Link signal medium mode (secondary connector)	Camera Link signal full mode (secondary connector)
1	1	inner shield	inner shield	inner shield
14	14	inner shield	inner shield	inner shield
2	25	X0–	Y0–	Y0–
15	12	X0+	Y0+	Y0+
3	24	X1–	Y1–	Y1–
16	11	X1+	Y1+	Y1+
4	23	X2–	Y2–	Y2–
17	10	X2+	Y2+	Y2+
5	22	Xclk–	Yclk–	Yclk–
18	9	Xclk+	Yclk+	Yclk+
6	21	X3–	Y3–	Y3–
19	8	X3+	Y3+	Y3+
7	20	SerTC+	unused	100 ohms
20	7	SerTC–	unused	terminated
8	19	SerTFG–	unused	Z0–
21	6	SerTFG+	unused	Z0+
9	18	CC1–	unused	Z1–
22	5	CC1+	unused	Z1+
10	17	CC2+	unused	Z2–
23	4	CC2–	unused	Z2+
11	16	CC3–	unused	Zclk–
24	3	CC3+	unused	Zclk+
12	15	CC4+	unused	Z3–
25	2	CC4–	unused	Z3+
13	13	inner shield	inner shield	inner shield
26	26	inner shield	inner shield	inner shield

Power

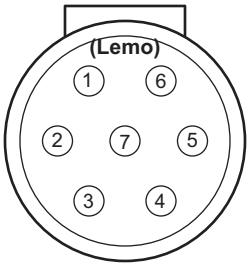
The power connector on the extender is either a standard coaxial Switchcraft or an optional Lemo. Pin information for both is shown in Figure 7.

Figure 7. Pinout – Standard Switchcraft Connector and Optional Lemo Connector



Outer ring is ground.

Pin 1 is power to extender (+4.75 to +18 V DC).



Key in connector barrel (at top).

Pin 2 is power to extender (+4.75 to +18 V DC).

Pin 7 is ground (for signals and power).

Pins 1, 3, 4, 5, and 6 (defined by firmware used in extender) typically are used at CMOS +3.3 V signal levels, though pins 1,6 and 3,4 can be configured as LVDS pairs.

With the Lemo, you can use various cables that allow auxiliary signals. (On medium- and full-mode systems using the resync cable option, the extenders at the framegrabber end must use Lemo connectors.)

Cable assembly – Lemo to loose wire

The Lemo to loose wire (EDT part #016-02650) can be wired as needed or connected to various types of connectors, depending on what you need for your application.

Table 7. Pinout – Lemo to loose wire

Lemo Pin	Wire Color	Standard Firmware (rgb11.rcx)	Signal Level	Comments
1 (output)	green	AUX_TX, primary auxiliary transmit UART	CMOS +3.3 V	All five CMOS 3.3 V signals go to FPGA I/O 3.3V pins using series 100-ohm resistors. Custom firmware can be used to configure these pins as input or output.
2	red	power to extender	+4.75 to +18 V	
3 (output)	orange	AUX2_TX, secondary auxiliary transmit	CMOS +3.3 V	
4 (input)	brown	AUX2_RX, secondary auxiliary receive	CMOS +3.3 V	
5	white	SYNC, can be configured as an outgoing copy of the camera's frame-valid signal	CMOS +3.3 V	
6 (input)	blue	AUX_RX, primary auxiliary receive UART	CMOS +3.3 V	
7	black	ground	ground	

Cable assembly – Lemo to male DB9

The male DB9 (EDT part #016-02718) supports signals that can be used as an auxiliary signaling system for a variety of purposes.

For example, custom firmware could allow the auxiliary signals to be used to control the camera's pan and servo motors. It is also possible to set up a hardware trigger that is local to either end. If you wish to explore these options, contact EDT.

Unlike the DB9 in the female assembly, this DB9 has no looped-back signals or integrated level conversion.

Table 8 shows the pinout and how the standard firmware uses each wire.

Table 8. Pinout – Male DB9 Cable

Lemo Pin	Color	DB9 Pin	Standard Firmware (rgb11.rcx)	Signal Level	Comments
–	–	1	[unused]	–	All five CMOS 3.3 V signals go to FPGA I/O 3.3V pins using series 100-ohm resistors. Custom firmware can be used to configure these pins as input or output.
–	–	6	[unused]	–	
1 (output)	green	2	AUX_TX, primary auxiliary transmit UART	CMOS +3.3 V	
2	red	9	power to extender	+4.75 to +18 V	
3 (output)	orange	7	AUX2_TX, secondary auxiliary transmit	CMOS +3.3 V	
4 (input)	brown	8	AUX2_RX, secondary auxiliary receive	CMOS +3.3 V	
5	white	4	SYNC, can be configured as an outgoing copy of the camera's frame-valid signal	CMOS +3.3 V	
6 (input)	blue	3	AUX_RX, primary auxiliary receive UART	CMOS +3.3 V	
7	black	5	ground	ground	

Cable assembly – Lemo to female DB9 RS232

The female DB9 (EDT part #016-02445) supports integrated CMOS +3.3 V to RS232 level converters on a small circuit board inside the DB9 connector shell.

This cable is designed to plug in directly to a host computer serial port. The cable offers an auxiliary UART connection over the fiber, in addition to the UART normally associated with the Camera Link standard. This auxiliary UART can be used, for example, to control the camera's pan and zoom servo motors from the host at 19.2 Kb/s or less. Alternatively, it can be used for other low bandwidth signals.

Unlike the DB9 in the male assembly, this DB9 does not supply power to the extender. Instead, a red wire (power) and a black wire (ground), both 24 inches long, are left loose so you can hook up your own power source. The required power is 4.75 to 18 V DC.

Table 9 shows the pinout and how the standard firmware (in `rgb11.rcx`) uses each wire. DB9 pins 1, 4, and 6 are wired together and unconnected, 7 and 8 also are wired together, and 9 also is unconnected; these signals are not otherwise used.

Table 9. Pinout – Female DB9 Cable

Lemo Pin	Wire Color	DB9 Pin	Standard Firmware (rgb11.rcx)	Signal Level
–	–	1	[unused]	–
–	–	6	[unused]	–
1 (output)	green	2	AUX_TX, primary auxiliary transmit UART	RS232 (at DB9) to CMOS +3.3 V (at Lemo)
2	red	9	power to extender	+4.75 to +18 V (red wire out)
3	orange	7	reserved	–
4	brown	8	reserved	–
5	white	4	reserved	–
6 (input)	blue	3	AUX_RX, primary auxiliary receive UART	RS232 (at DB9) to CMOS +3.3 V (at Lemo)
7	black	5	ground	ground (black wire out)

Cable assembly – Lemo resync

The resync cable, for medium or full mode, sends a common clock signal from an oscillator inside the DB9 shell to each of the two extenders at the framegrabber end. This cable also allows the X channel extender to signal the YZ channel extender when to start each raster.

The two Lemo connectors on the resync cable are interchangeable.

The resync cable must have an oscillator frequency greater than or equal to the camera pixel clock rate. The pixel clock re-created for the framegrabber is asynchronous to that generated by the camera; thus, the amount of time spent in horizontal blanking varies from one raster line to the next. If the camera's clock rate is slower than that of the resync cable, a greater percentage of time will be spent in horizontal blanking at the framegrabber. Resync cables for 40, 60, and 80 MHz are available (see Related Resources on page 6).

From the tables under Configuration and LED Configuration Codes on page 11, select a configuration code with a frequency range that is included in the frequency generated by the cable assembly.

Table 10 shows the pinout for this cable with a male DB9 connector.

Table 10. Pinout – Resync Cable with Male DB9

Lemo Pin	Lemo Signal	DB9 Signal	DB9 Pin
1	START_RASTER+, LVDS signal from X to YZ extender	[unconnected]	—
2	power	power	9
3	CLOCK+, LVDS pixel clock into X and YZ extenders	[unconnected]	—
4	CLOCK-, LVDS pixel clock into X and YZ extenders	[unconnected]	—
5	reserved	[unconnected]	—
6	START_RASTER-, LVDS signal from X to YZ extender	[unconnected]	—
7	ground	ground	5

If you use the resync cable, you will need a power source as well (see Power Supply, below).

Power Supply

Each extender has an internal switching regulator that supports voltages of 4.75 to 18 volts DC. For pin information and polarity on the standard Switchcraft and the optional Lemo connector, see Power on page 20.

CAUTION To avoid damage to the extender, EDT recommends that you protect it from power spikes over 18 V, use voltages at the lower end of the range, and never reverse the polarity of the power connector.

Table 11 shows the base-mode power supply requirements for an extender at the camera end.

Table 11. Base-mode power supply for extender at camera end

	U.S.	International	International with DB9 connector
Voltage in	100–240 V, 50–60 Hz from AC mains	100–240 V, 50–60 Hz from AC mains	100–240 V, 50–60 Hz from AC mains
Voltage out	5 V, 1 A (DC); power supply includes a U.S.-standard power plug.	5 V, 2 A (DC); power supply includes four international power plug adapters.	5 V, 2 A (DC); power supply includes four international power plug adapters.
Connector	Switchcraft 760K	Switchcraft 760K	DB9 female

In full mode with a standard framegrabber, the power required for each end (camera and framegrabber) is always under 6 watts – and typically closer to 4 watts – per end. This power is spread across two extender (typically 1.5 watts for the X channel unit, and 2.5 watts for the YZ channel unit). The two extenders at the camera end can use either of the two power supplies with the Switchcraft connectors, while the two extenders at the framegrabber end can receive power from the EDT resync cable through a female DB9 connector. The resync cable connects to the extenders through two interchangeable Lemo connectors.

Dimensions

This section covers the dimensions for EDT extenders.

Figure 8 shows the dimensions of a typical extender. The power connector dimension of 0.31 inch is for the standard power connector; the optional Lemo connector on the fiber version is approximately 0.35 inch.

NOTE Connector dimensions are approximate; for precise dimensions, see the manufacturer's specifications.

Figure 8. Extender Dimensions

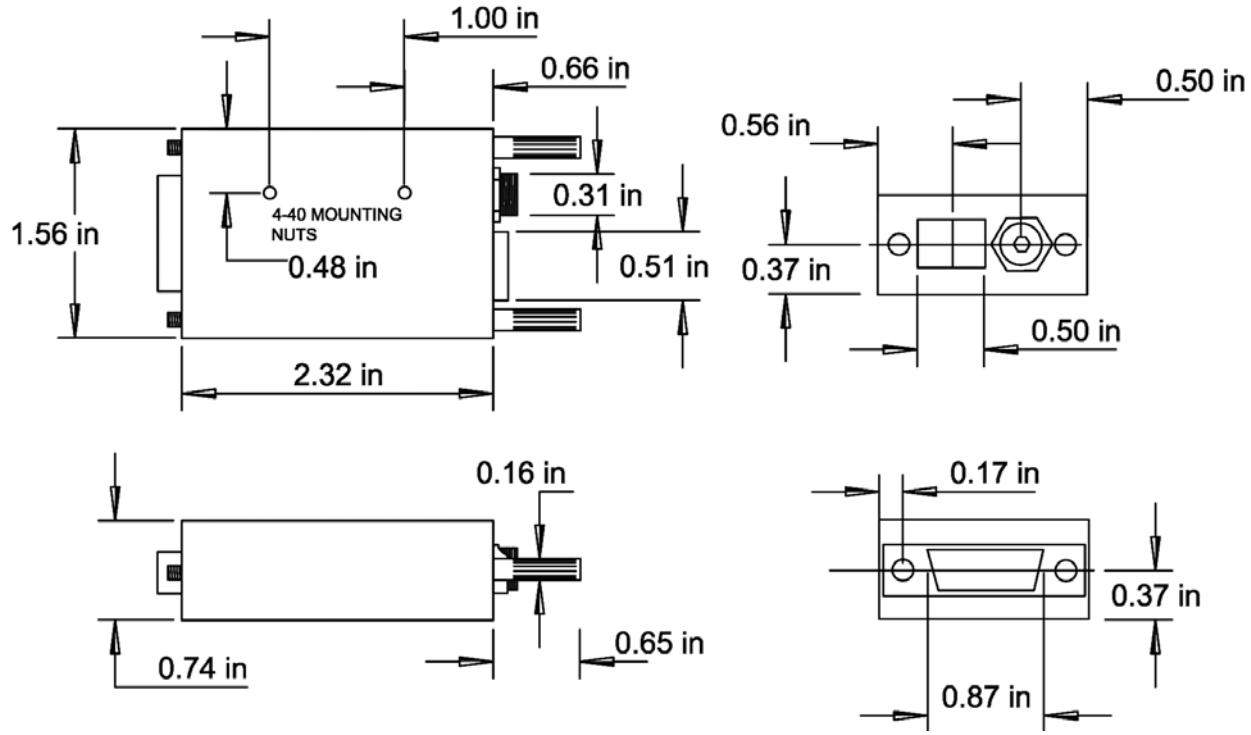
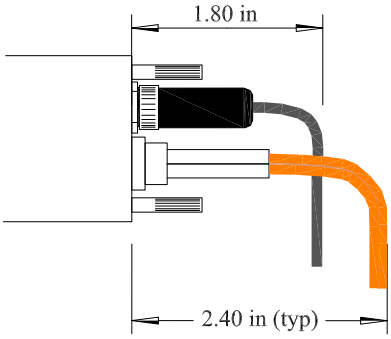


Figure 9 shows a typical value for cable clearance; the exact value is dependent upon the cable used.

Figure 9. Cable Clearance



Appendix

Alternative Mounting and Connecting Methods

Your setup may require an alternative method to mount an extender to a device. For example, to mount a coax extender (which has no thumbscrews), you'll need to use one of these methods.

Mounting Holes

You can mount the extender via its mounting holes, as in Figure 10, and a custom (user-provided) bracket.

Figure 10. Mounting Holes

CAUTION To avoid damage to the extender, mounting screws must not extend more than 0.2" into the case. See Dimensions on page 24.

Adapter Cabling

If you cannot mount your extender directly to your device, you can use an EDT adapter cable or an optional third-party cable. Figure 11 shows EDT's half-meter cables, with part numbers and instructions.

Figure 11. EDT extenders with EDT half-meter adapter cables

Fiber extender + EDT adapter cable #016-02563

With this cable, screw the fiber extender's thumbscrews through the end of the EDT cable and firmly into the MDR26 connector on the cable.

Coax extender + EDT adapter cable #016-03946

With this cable, screw the screws (with washers) on the EDT cable through the cable backshell, and firmly into the MDR26 connector on the coax extender.

Also, for devices with SDR (mini Camera Link) connectors, EDT offers a 3M MDR26 female to SDR26 male cable in two lengths: 1 meter (EDT part #016-013779); or 2 meters (EDT part #016-13740).

Revision Log

Below is a history of modifications to this guide for EDT's RCX C-Link Series.

Date	Rev	By	Pp	Detail
20120809	03f	PH	7	In section called Connecting the Extender Assembly... • In Figure 1, added this note: "**IMPORTANT:** Full / medium mode units are not interchangeable with base mode units. One exception is X-channel camera-end units (part numbers 02188 and 02281), which can be reconfigured from full / medium mode to base mode (and vice versa) via a firmware update. For details, see Firmware on page 16."
20120809	03f	PH	16	In section called Firmware... • Under Versions, in Table 4, added this note: "**IMPORTANT:** Full / medium mode units are not interchangeable with base mode units. One exception is X-channel camera-end units (part numbers 02188 and 02281), which can be reconfigured from full / medium mode to base mode (and vice versa) via a firmware update." • Moved this note (formerly halfway down the page, under Querying, Verifying, and Updating - now slightly revised as follows) to go right under main Firmware heading: "If you are using EDT FOX or PCI Express framegrabbers and fiber extenders in base or medium mode, you can query and, if appropriate, update the firmware. If you are using anything else, contact EDT to update the firmware."
20120515	03f	PH	All	• Repaginated to use continuous arabic numerals from title page to end. • Implemented new terminology: Changed "digital video" to "vision" or "digital imaging."
20120501	03e	CH,JG, PH	12	• Under Firmware, Version, Table 4, in the row for Medium operating mode, in the column for Channel, changed the YZ to a Y only, per JG.
20120316	03e	JG,PH	16-17	• In Tables 7-9, specified which Lemo pins are input and which are output.
20111013	03d	PH+RH, CH, et al	8	• Added note under Table: "PCI DV FOX supports rates only up to 1.25 Gb/s, so it works only with RCX C-Links configured at 1-1 or 1-2."
20110629	03d	RH,CH, TL,PH	14	• Revised Coaxial Cable main section to include more 50-ohm information and no 75-ohm information (not part-numbered).
20110624	03c	RH,PH	14	• Added Coaxial Cable main section (with 50- and 75-ohm information).
20110624	03c	RH,PH	14	• Deleted Options main head and moved its two subsections as follows: - made Transceivers a main section (moved above Pinouts); - renamed Power Connector (re. Lemo cable options) to Power and moved it under Pinouts.
20110624	03c	RH,PH	16	• Made Camera Link pinout its own subsection (Camera Link) under Pinouts.
20110624	03c	RH,PH	16,18	• In sections entitled Pinouts and Power Supply, added clarifying details and a figure showing the standard Switchcraft vs. the optional Lemo power connector.
20110523	03b	CH,PH	18	• Under Power Supply, expanded the opening verbiage to: "Each extender has an internal switching regulator that supports voltages of 4.75 to 18 volts DC. The polarity for the power connector is center pin positive (+), outer collar negative (-). CAUTION - To avoid damage to the extender, EDT recommends that you protect it from power spikes over 18 V, use voltages at the lower end of the range, and never reverse the polarity of the power connector."

Date	Rev	By	Pp	Detail
20110307	03b	PH	16-17	• Under Options - Power Connector: - Loose wire – added new section and table for this option. - Male and female – reformatted tables to match loose wire assembly table.
20110216	03a	PH	20	• Added to Appendix: information about SDR cable connectors.
20110211	03	PH	All	• Added information about new products (coax extender and PCIe framegrabber).
20100000	02	PH	All	• Updated guide with new page layout and formats.
20000000	01	LW	All	• Created new guide.